

UN environment programme | finance initiative

Principles for Sustainable Insurance

From Vulnerability to Insurability

How the insurance industry can catalyze resilience across the economy in an era of rising physical climate risk

A white paper produced by
UN Environment Programme's
Principles for Sustainable
Insurance Initiative (PSI)

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About the UN Environment Programme's Principles for Sustainable Insurance Initiative

Developed by the UN Environment Programme's Finance Initiative, the Principles for Sustainable Insurance (PSI) were launched at the 2012 UN Conference on Sustainable Development (Rio+20) and have led to the most extensive global network of insurance and stakeholder organizations committed to addressing sustainability risks and opportunities.

Endorsed by the UN Secretary-General and insurance industry CEOs, the PSI serves as a global voluntary and aspirational framework for insurers to manage sustainability risks and opportunities in core business strategies and operations and across their spheres of influence. The work of the PSI Initiative strengthens the insurance industry's contribution as risk managers, risk carriers and investors to building resilient, inclusive and sustainable communities and economies on a healthy planet.

Learn more at: unepfi.org/psi

"The Principles for Sustainable Insurance provide a global roadmap to develop and expand the innovative risk management and insurance solutions that we need to promote renewable energy, clean water, food security, sustainable cities and disaster-resilient communities."

UN Secretary-General
(PSI launch, 2012 UN Conference on Sustainable Development)

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Glossary of terms

Adaptation	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC 2022). Examples include building flood defences or relocating critical equipment.
Adaptation limits	The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions (IPCC 2022). **Hard adaptation limit:** No adaptive actions are possible to avoid intolerable risks. **Soft adaptation limit:** Options are currently not available to avoid intolerable risks through adaptive action.
Avoided losses (working definition)	The reduction in expected losses from a hazard when a risk-reduction or adaptation measure is in place, calculated by comparing modelled losses with and without the measure.
Bankability	The extent to which a project or asset is considered acceptable to lenders and investors, including how well its risks are understood and managed.
Bind	To accept a risk and confirm that insurance cover takes effect.
Business interruption	Loss of income and additional costs arising when operations are disrupted by an insured event.
Captive insurance company	An insurer established and owned by one or more non-insurance organizations primarily to insure the risks of its owner or owners.
Catastrophe bond (cat bond)	A security through which insurance or reinsurance risk is transferred to capital-market investors; investors may lose some or all principal when a specified catastrophe trigger is met.
Correlation (of losses)	The tendency for losses to occur together, as when a single flood or wildfire affects many insured properties at once.
Excess (deductible)	The amount of an insured loss that the policyholder is required to bear before the insurer pays the balance, subject to the policy terms.
Exclusion	A policy provision that removes specified risks, perils, circumstances or losses from insurance cover.
Expected loss	The average loss anticipated over time, based on the likelihood and severity of events.

Exposure	The presence of people; livelihoods; species or ecosystems; environmental functions, services and resources; infrastructure; or economic, social or cultural assets, in places and settings that could be adversely affected (IPCC 2022). It could be people, property, assets or other interests that may be affected by a hazard and consequently give rise to loss. In insurance, exposure can also refer to the amount of risk an insurer has accepted.
Hazard	The potential occurrence of a natural or human induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources (IPCC 2022). It could be a potentially damaging physical event or condition, such as flood, wildfire, windstorm, drought or extreme heat, that may cause loss or damage to exposed assets or people.
Insurability	The extent to which a risk can be covered at a price and on terms that are workable for both insurer and policyholder.
Insurance-linked securities (ILS)	Financial instruments, including catastrophe bonds, that transfer insurance risk to capital markets.
Mitigation (of climate change)	A human intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC 2022).
Natural catastrophe (NatCat) models	Models that estimate losses that may arise from natural catastrophe events across individual assets, portfolios or regions.
Nature-based solutions[1]	Actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits.
Perils	Specific causes of loss that an insurance policy may cover or exclude, such as flood, windstorm, wildfire or subsidence. Whether a peril is covered depends on the policy terms.
Physical climate risk	Risk of loss and damage from climate-related hazards, whether acute (e.g. storms, floods) or chronic (e.g. sea-level rise, rising temperatures).
Policy limit	The maximum amount an insurer will pay under a policy or for a given type of loss.
Premium	The price paid by the policyholder for insurance cover.
Primary perils	Natural catastrophes that tend to occur less frequently but can cause very large losses, such as tropical cyclones (including hurricanes).
Protection gap	The difference between total economic losses from a hazard and the portion covered by insurance. It measures how much loss falls on households, businesses and governments rather than insurers. It is widest for climate-related natural catastrophes and in lower-income countries, where insurance penetration is low.

1 As per UNEP/EA.5/Res 5 of 7 March 2022, UNEP_EA.5_RES.5-EN.pdf.

Reinsurance	Insurance purchased by insurers to transfer part of their risk to other insurers (i.e. reinsurers).
Resilience	The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation (IPCC 2022). An example is the ability of assets, businesses and communities to anticipate, withstand, recover from and adapt to climate impacts.
Risk appetite	The amount and types of risk an insurer is willing to accept in pursuing its objectives.
Risk engineering	Technical assessment of facilities and operations to identify vulnerabilities and recommend measures to reduce risk.
Risk pooling (mutualization)	Combining premiums from many policyholders so that the losses of a few are met from the contributions of the many.
Scenario analysis	Examining how outcomes may differ under alternative assumptions, such as different warming pathways.
Secondary perils	Natural catastrophes that occur relatively frequently and have typically caused small to mid-sized losses per event individually, although together they can account for a large share of insured losses. Examples include severe convective storms (including hail), large floods, droughts and wildfires.
Self-insurance	The deliberate retention of risk by a business or individual rather than transferring that risk to an insurer, with losses funded from their own resources if they occur.
Subsidence	Downward movement of the ground beneath a building, which can be worsened by hotter, drier conditions shrinking clay soils.
Underwriting	The process of assessing an insurance risk and deciding whether to accept it and, if accepted, on what terms and at what price.
V20	The Vulnerable Twenty Group of Ministers of Finance, a cooperation group of finance ministers from economies that are highly vulnerable to climate change. It is part of the Climate Vulnerable Forum, and it advocates for climate finance and for stronger financial protection and resilience in its member countries.
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm, and the lack of capacity to cope and adapt (IPCC 2022). It could be the characteristics of an asset, business or community that determine how susceptible it is to damage or loss when exposed to a hazard.

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Executive summary

Physical climate events are increasing in both severity and frequency, driving higher losses and growing pressure on the affordability and availability of insurance. Where insurance becomes unaffordable or unavailable, losses fall directly on businesses and households, who must fund recovery from working capital, reserves or savings, take on debt or leave damage unrepaired. Governments can bear a significant share of these costs, funding recovery activities, absorbing lost tax revenue and managing broader impacts on community stability. The consequences extend well beyond direct losses: uninsured and underinsured assets face tighter credit, declining values and deferred investment.

Reducing risk before losses occur is therefore critical. Climate change mitigation and adaptation go hand in hand: mitigation reduces emissions, limiting future warming, while adaptation reduces vulnerability to the physical impacts that cannot be avoided. Investment in adaptation can deliver clear returns, protecting not only physical assets but also the continuity of operations, demonstrating that resilience can be a source of competitive advantage. Yet adaptation finance remains far below assessed need. Many of today's insurability challenges arise in places where adaptation could materially reduce risk but remains underfunded, undervalued, misunderstood or inadequately assessed.

Closing the adaptation gap will require action across governments, the financial sector and businesses, and insurers have a distinctive role to play. There are six ways in which insurers can support adaptation and resilience, as shown in Figure 1.

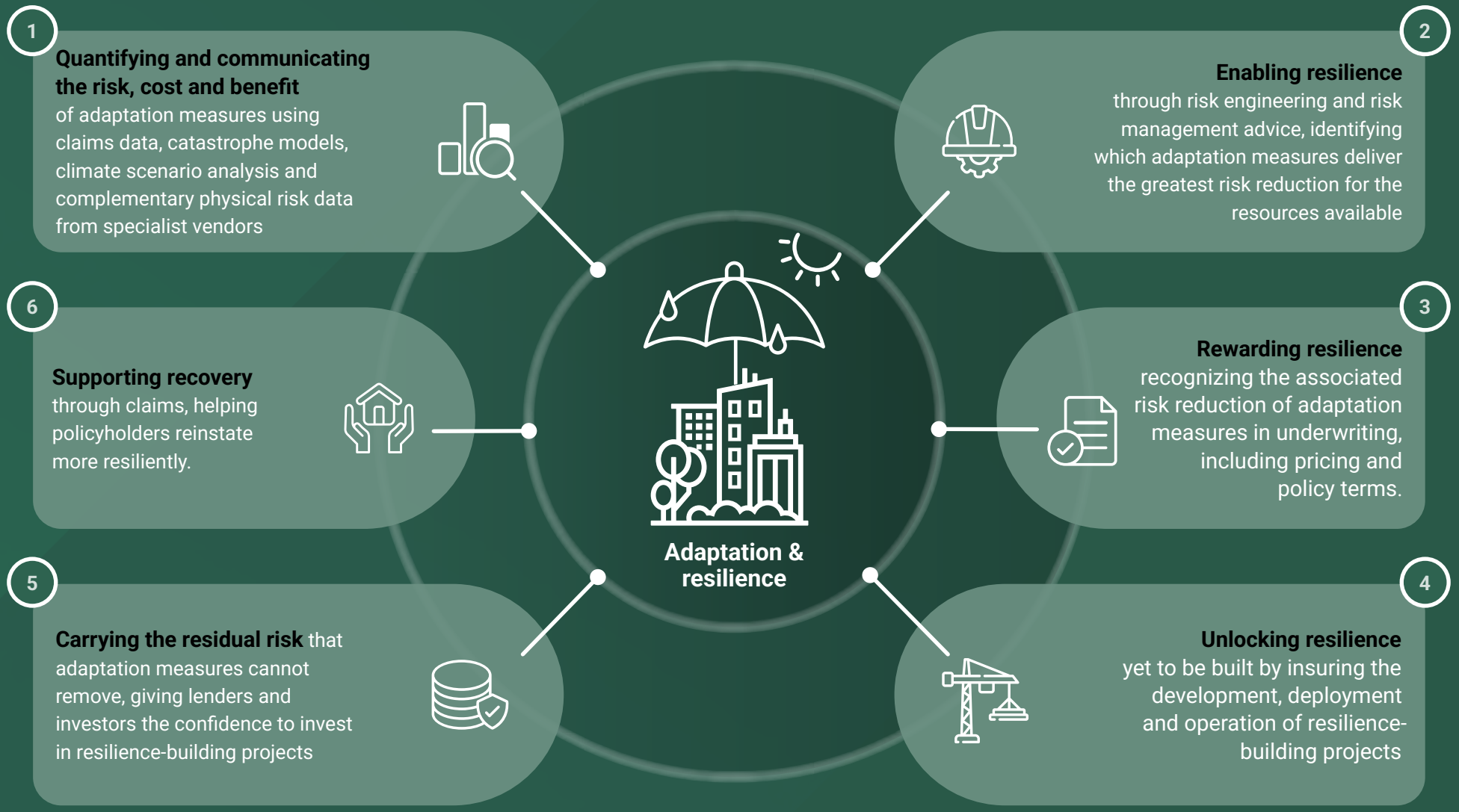


Figure 1: How insurers can support adaptation and resilience

These capabilities can support those who own, operate and finance climate-vulnerable assets, projects and businesses before disasters—by preventing losses and building better—and by supporting recovery from losses and building back better. Together, these actions help to reduce asset vulnerability and sustain insurability. Insurability, in turn, can underpin asset bankability and investability, maintaining access to finance and contributing to the stability of communities and economies. The result is a reinforcing cycle: insurance supports resilience, resilience sustains insurability, and insurability unlocks the financing of further resilience and wider investment. The same cycle can also work in reverse—losses can drive higher premiums, and increased risk can tighten access to finance and reduce investment.

Scaling resilience will require action beyond the insurance industry. Those who own and operate assets can invest in reducing risk. Lenders, investors and insurers can recognize resilience in their decisions whether through mobilizing capital or setting underwriting terms. Policymakers, regulators and public authorities can create and require the conditions for resilience to be recognized, valued and rewarded at scale. **The choice is stark: invest in resilience now or pay even more for losses later.**

This paper calls on insurers and reinsurers, households, businesses, financiers, policymakers, regulators and public authorities to work together, exercise their agency and act urgently to make resilience a priority, before losses become the norm, rather than the exception. In an era of rising physical climate risk, transforming vulnerability to insurability and catalyzing systemic resilience is a fundamental economic and social imperative.

1. Aims, scope and target audience

Aims and scope

The paper has three principal aims, based on the premise that insurers can act as catalysts for adaptation and resilience through quantifying risk, enabling and rewarding its reduction, unlocking and de-risking resilience, and supporting recovery.

1 Establish the imperative for adaptation and resilience

In the face of rising physical climate risk and degraded natural buffers, it is imperative to increase understanding of the issue and accelerate solutions to minimize the impacts. The paper examines how adaptation measures can reduce losses and disruption, help maintain the insurability of climate-vulnerable assets and businesses, and support longer-term economic stability.

2 Outline insurance industry risk-management capabilities and how these can support resilience initiatives, and therefore capital mobilization

The insurance industry's risk-management capabilities, including catastrophe modelling, risk engineering and underwriting, can support adaptation and resilience across the economy.[2] This paper explores how these capabilities can help quantify resilience, improve the risk profiles of climate-vulnerable assets and businesses, and strengthen confidence among lenders and investors.

3 Catalyze a whole-of-society approach to building resilience

Scaling adaptation and resilience requires action from those who own, operate and finance assets, alongside policymakers, regulators and public authorities. Insurers play a critical role as part of a broader enabling environment.

The paper also emphasizes the need for earlier and more proactive engagement between stakeholders so that insurance capabilities are used to support pre-disaster risk reduction and resilience investment, rather than being engaged primarily for post-disaster relief and recovery.

2 Beyond these risk-management capabilities, insurers can also contribute to enhancing and financing adaptation and resilience through their investment portfolios as major institutional investors. The focus of this paper is on the insurance activities rather than their role as asset owners.

Target audience

The paper's primary audience is those who own, operate and finance assets across the real economy, including households, businesses, banks, investors and development finance institutions, together with policymakers, regulators and public authorities. These stakeholders shape adaptation, resilience and investment outcomes, and are key users of the risk insights and capabilities discussed throughout this paper.

Insurance market participants including insurers, reinsurers, brokers and risk-model vendors constitute an important secondary audience. Through their risk expertise and underwriting, including the pricing signals this generates, they have a central role in supporting resilience and informing decision-making across the wider economy.

Beyond insights from a global and diverse group of 30 insurance and stakeholder organizations that comprise the Principles for Sustainable Insurance (PSI) Adaptation & Resilience Working Group, this paper draws on interviews with stakeholders across the wider financial sector, real economy and public policy, including the Principles for Responsible Banking (PRB), Principles for Responsible Investment (PRI), International Actuarial Association (IAA), National Climate Change Secretariat of Singapore, Singapore Sustainable Finance Association (SSFA), and World Business Council for Sustainable Development (WBCSD). It has also benefitted from insights at key 2026 events such as the UNEP Transition Insurance Series during London Climate Action Week and the UNEP Global Sustainable Insurance Summit in Dublin, Ireland.

2. The importance of climate resilience

> **"This summer was the summer of truth… These were the hottest summer months ever—but probably the coolest of the years to come."[3]**

With these words, the President of the European Commission captured the scale of the challenge in her 2026 State of the Union Address, which also announced a Climate Insurance Alliance to help close Europe's insurance gap, especially since only around 25% of catastrophe losses in Europe are covered by private insurance.[4] It is estimated that the 2026 summer's extreme heat could cost EU economies around EUR 180 billion, roughly 1% of EU GDP.[5] This reflects a wider global trend: climate-related events are becoming more frequent and severe, driving escalating economic losses that disrupt households, businesses and entire economies. At the same time, population growth and continued development in high-risk areas, particularly unplanned urban expansion, continue to increase exposure and vulnerability.

However, the impacts of physical climate risk are not felt equally: developing economies are often among those most exposed to physical climate risk and the least able to absorb its impacts. The Vulnerable Twenty Group of Ministers of Finance (V20) estimates that from 2000 to 2019, its then-55 member economies lost approximately 20% of their combined GDP due to the climate-related losses incurred during that period.[6,7] These losses also add debt pressure, especially heavily indebted developing countries who may need to borrow more to fund recovery, such as replacing bridges, homes and jobs that were lost.

As losses grow, communities, businesses and governments face increasing pressure to finance recovery. Recent analysis by MSCI, shown in Figure 2, finds that locations with higher exposure to hazards such as floods, wildfires, storms and hail are more likely to experience rising claims pressure, which can translate into higher premiums and tighter cover terms.

3 European Commission, *2026 State of the Union Address by President von der Leyen*, 2026. Available at: ec.europa.eu/commission/presscorner/detail/ov/SPEECH_26_1868

4 Ibid.

5 Triodos Bank, *Hot Summer Economics*, August 2026. Available at: triodos-im.com/articles/2026/extreme-heat-could-wipe-out-eu-economic-growth-in-2026

6 Vulnerable Twenty Group of Ministers of Finance (V20), *Climate Vulnerable Economies Loss Report*, 2022. Available at: v-20.org/resources/publications/climate-vulnerable-economies-loss-report

7 As of November 2026, V20 member economies stood at 74 nations with a total population of 1.7 billion and GDP value of US$ 4.1 trillion. Available at: cvfv20.org/membership/

Insurance cost growth hotspots today

Modelled insurance risk from flood, wildfire, wind and hail hazards

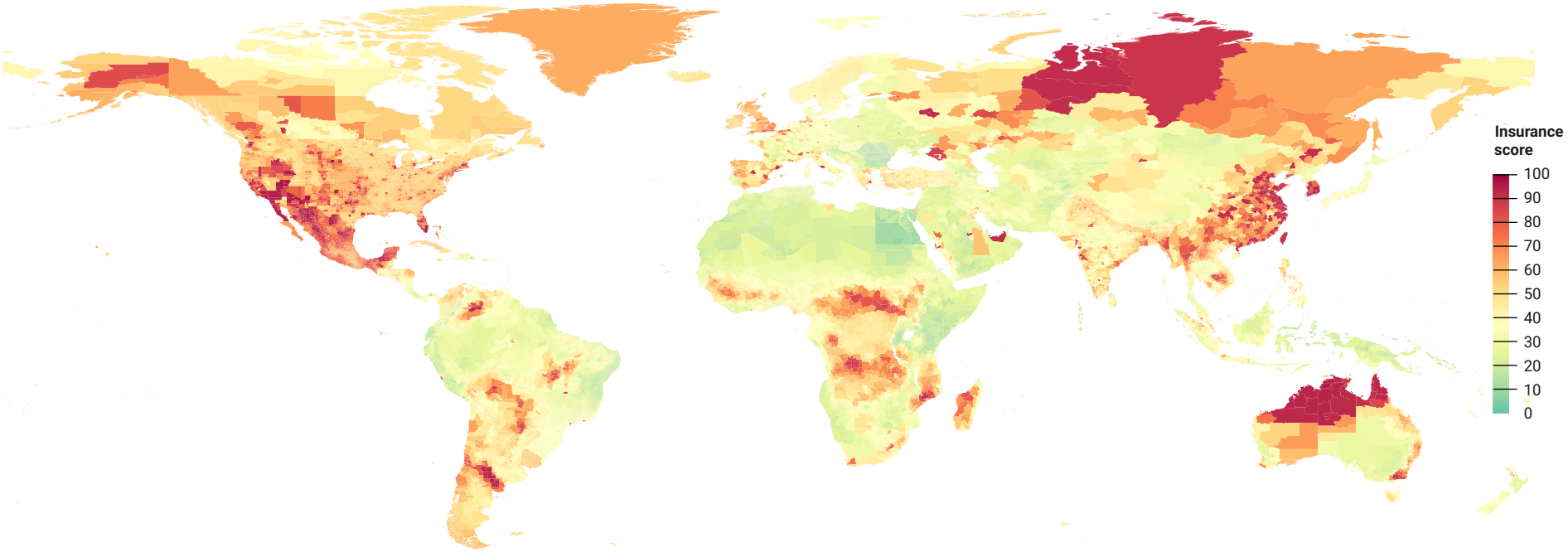


Figure 2: Global map of forecast insurance cost growth hotspots. Source: MSCI Sustainability & Climate Research. Data as of 16 June 2026. The map presents outputs from the Insurance Factor model powered by First Street. Higher Insurance Scores indicate greater modelled insurance premium cost growth and volatility associated with physical risks from flood, wildfire, storm/wind and hail hazards.

These pressures play out differently across markets. In many high-income countries, the concern is declining affordability or availability of cover, while in many developing countries insurance access and penetration have been limited for decades. Together, these leave around half of global economic losses from natural catastrophes uninsured, a shortfall known as the protection gap.[8]

Expanding insurance coverage alone cannot close this gap because some economic losses are not commercially insurable. Moreover, the absence of insurance coverage does not necessarily mean that a risk is unmanaged. Some businesses and households deliberately retain risk themselves through self-insurance, while others remain uninsured because cover is unavailable, unaffordable or not purchased—headline protection gap figures do not distinguish between the two. MSCI analysis suggests that self-insurance is already a common approach to managing rising climate-related insurance costs, as shown in Figure 3.

How firms cover climate-driven insurance risk
Share of 10-K filings disclosing each coverage approach, 2024

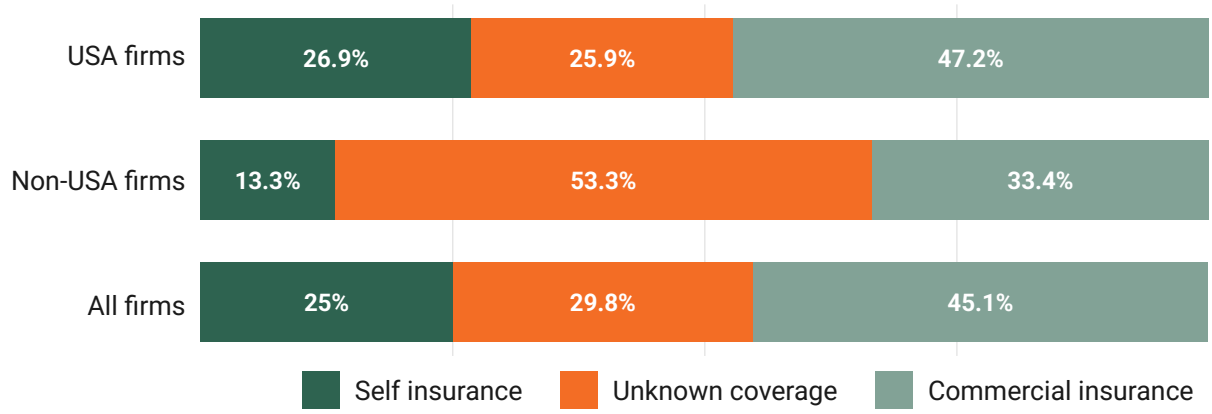
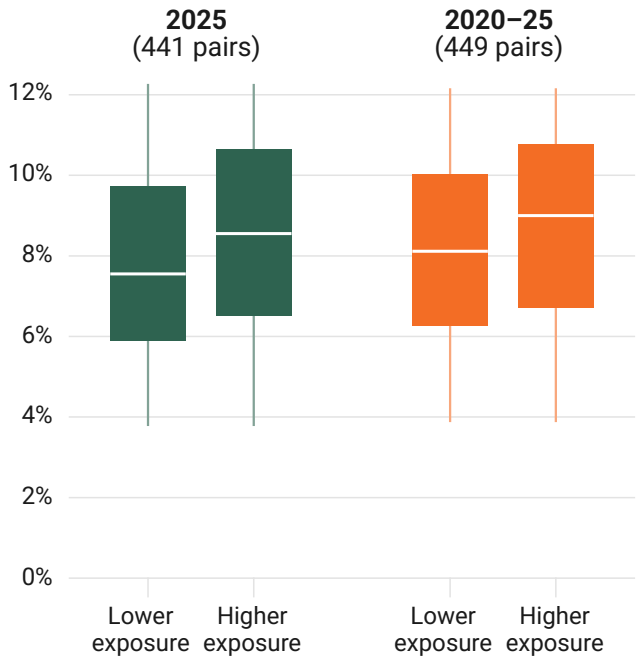


Figure 3: Prevalence of self-insurance. Source: MSCI Sustainability & Climate Research. Data as of 11 February 2026. Analysis of 2024 10-K filings submitted to the US Securities and Exchange Commission (SEC). Coverage approaches are identified using keyword matches including "self-insurance", "captive insurance", "risk retention" and related terms. US and non-US firms are classified by company domicile. "Unknown coverage" indicates filings where a coverage approach could not be identified using the search methodology.

As physical climate risks intensify, more of the risk is likely to fall outside commercial insurance. Where cover is unavailable or unaffordable, households and businesses may be left exposed, while assets and projects may become more difficult to finance. Lenders and investors often treat insurance as a signal that a risk is understood, has been assessed and can be transferred. Where that signal weakens, the cost of capital may increase, and investment may shift towards less climate-vulnerable assets or locations. Awareness of the link between rising insurance costs, bankability and asset valuation is growing, but investors have yet to apply it systematically. Figure 4 shows the relationship between the cost of capital and physical risk exposure. The implications extend well beyond uninsured losses, ultimately affecting wider economic stability.

8 Aon, *Climate and Catastrophe Insight*, 2026. Available at: aon.com/en/insights/reports/climate-and-catastrophe-insight

Higher physical risk exposure was associated with a cost of capital premium



- The higher and lower exposure groups are based on hazard exposure (MSCI hazard intensity scores).
- Propensity score matching (PSM) was used to adjust high and low exposure groups for industry, market cap, region, debt-to-equity ratio and beta.
- From the universe of ACWI, 441 pairs and 449 pairs for 2025 and 2020–2025 respectively were identified for this PSM analysis.
- On average WACC is 0.64 p.p. greater for the higher exposure group compared to lower exposure group in 2020. Over the 2020–25 period, the trend maintains with a gap 0.59 p.p.

Figure 4: Impact of high physical risk exposure on the cost of capital. Source: MSCI Sustainability & Climate Research. Analysis covers MSCI ACWI Index constituents from 1 January 2020 to 31 December 2025. Propensity score matching (PSM) compared weighted average cost of capital (WACC) across companies with higher and lower physical risk exposure, controlling for industry, size, region, leverage and beta. Higher exposure denotes a hazard intensity score above 7 (on a 0–10 scale) for wildfire, extreme heat or tropical cyclones, based on 2025 exposure levels. Results were significant at the 99.9% confidence level.

While the need for adaptation and resilience is urgent, it cannot be pursued in isolation. Addressing physical climate risk urgently requires both mitigation and adaptation.[9] Mitigation limits the scale of future warming, and with it, the extent of future physical risk. Adaptation reduces vulnerability to the physical risks that are already occurring and can no longer be avoided, building the resilience that helps assets, businesses and communities remain or become insurable.[10] Mitigation and adaptation are interdependent: the more warming is limited, the less difficult and costly adaptation becomes. The insurance industry can and should contribute to both mitigation and adaptation, because only together do they create a resilient, prosperous future in which insurance and economies thrive.

9 United Nations Environment Programme (UNEP), *Limiting Overshoot: Navigating Exceedance of 1.5°C and Pathways Towards Return*, 2026. Available at: wedocs.unep.org/items/156d074c-ab1d-4833-acf8-6343589ede9b

10 Intergovernmental Panel on Climate Change (IPCC), *AR6 Glossary*, 2022. Available at: apps.ipcc.ch/glossary/

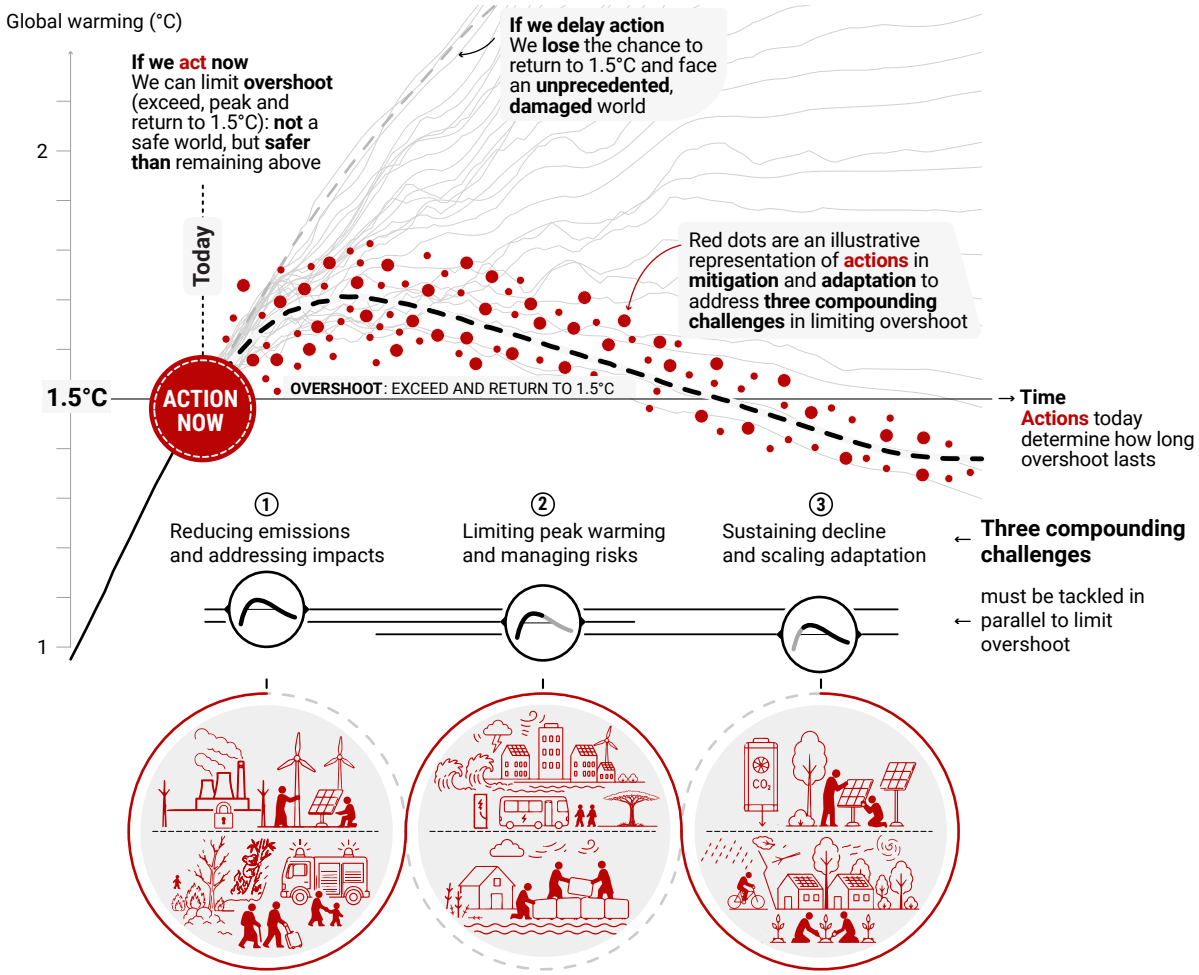


Figure 5: Interaction between mitigation and adaptation. Source: UNEP *Limiting Overshoot* report

The economic case for investing in adaptation and resilience is strong. A report synthesizing nearly 300 studies finds an indicative median benefit-cost ratio of around 4:1 on adaptation investment, alongside a societal internal rate of return of approximately 25%.[11] The report describes a "triple dividend", where adaptation prevents losses, stimulates economic activity, and delivers wider social and environmental benefits. Despite this economic case, adaptation remains substantially underfunded and undervalued in financing, investment and policy decisions.

In developing countries alone, adaptation finance needs are up to US$ 305 billion per year by 2035, nearly 11 times current international public adaptation finance flows.[12] Where adaptation needs are great but access to long-term capital is more constrained, as in the Global South, sovereign action and blended-finance mechanisms are likely to play an increasingly important role in mobilizing resilience investment, using public and concessional capital to attract private-sector participation and improve project bankability.

Nevertheless, adaptation cannot eliminate all risk because it faces *hard limits* where no amount of adaptation can prevent loss (e.g. low-lying islands become permanently uninhabitable as sea levels

11 Grantham Research Institute on Climate Change and the Environment, *The Macroeconomic Case for Investing in Climate Adaptation*, London School of Economics and Political Science, 2026. Available at: lse.ac.uk/granthaminstitute/publication/the-macroeconomic-case-for-investing-in-climate-adaptation/

12 United Nations Environment Programme (UNEP), *Adaptation Gap Report 2026: Ready? Not.*, 2026. Available at: unep.org/en/publications/report/adaptation-gap-report-2026

rise or coral reefs disappear when ocean temperatures exceed corals' thermal tolerance), and *soft limits*, where adaptation options exist but may be held back by financial, technical or institutional constraints.[13]

Many of today's insurability challenges stem not from the impossibility of adaptation but from adaptation measures not yet deployed at scale. This is where the insurance industry's capabilities can make the greatest difference. By quantifying the risk, evidencing the value of risk reduction and rewarding it through underwriting, insurers can help strengthen resilience. Resilience improves insurability, and continued insurability supports access to lending and investment, helping to strengthen financial and economic resilience in a warming and increasingly vulnerable world.

13 United Nations Environment Programme (UNEP), Limiting Overshoot: *Navigating Exceedance of 1.5°C and Pathways Towards Return*, 2026. Available at: wedocs.unep.org/items/156d074c-ab1d-4833-acf8-6343589ede9b

3. The role of insurers in catalyzing resilience across the economy

The insurance industry's risk intelligence and risk transfer functions give it a distinctive position from which to support climate adaptation and resilience. For more information on these functions, please refer to the Appendix, "Insurers and climate risk: Understanding the insurance *risk management continuum*".

Together, these functions allow insurers to catalyze systemic climate resilience through a reinforcing cycle as shown in Figure 6:

1. Insurance data, modelling insights, risk advisory and engineering services help businesses and households identify and understand their vulnerability and decide which adaptation measures to implement.
2. Where these adaptation measures are implemented, they reduce risk and improve the asset's resilience and insurability.
3. Insurance cover on favourable terms gives lenders and investors confidence that physical risk is understood and managed, further supporting access to lending and investment.
4. This, in turn, helps unlock capital and supports further investment in adaptation measures; exposure and vulnerability data can then evidence how effective those measures have been.

Each turn of the cycle strengthens the evidence base on which the next set of decisions is made.

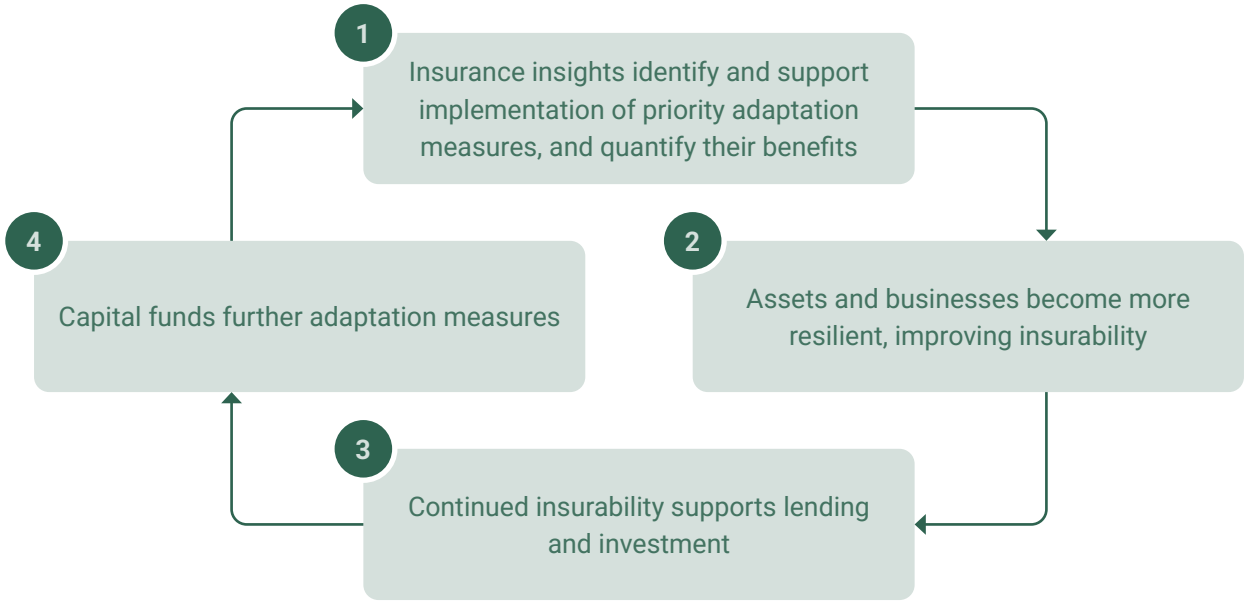


Figure 6: Cycle of resilience-building

The activities described in the *risk management continuum* demonstrate how insurers' capabilities can be applied to quantify, enable, reward, unlock and de-risk resilience across the economy.

a. Quantifying changing climate risk and evidencing resilience benefits using data and modelling

Insurers hold extensive datasets derived from underwriting activity and claims experience, showing how different assets have performed when exposed to physical climate hazards and which characteristics may drive vulnerability. Combined with NatCat model outputs and climate scenario analysis, this evidence base can help identify where assets are most vulnerable and which adaptation measures may be most effective under particular circumstances. This remains an emerging field, and many insurers may not yet be able to consistently measure how effective different adaptation measures are. However, this capability could have significant benefits for increasing resilience, and insurers are in a strong position to advance understanding over time.

The same data could enable insurers to put a value on those adaptation measures. By comparing how an asset is expected to perform with and without a specific intervention across a range of hazards and future scenarios, insurers could estimate by how much adaptation strengthens the asset's risk profile; for example, through reduced expected losses, or smaller losses in a severe event. This requires understanding both how adaptation measures affect vulnerability and how their effectiveness may change over time, as well as how climate change is altering the underlying hazards. Assessing these changes requires stronger data capabilities and climate science to understand how the frequency and severity of rapid-onset events (e.g. severe convective storms, flash floods, extreme wildfires) may evolve, particularly for perils that are less well understood, such as hail, as well as slow-onset events (e.g. sea level rise, rising temperatures, desertification and land degradation). For these estimates to be comparable across insurers and markets, and useful to lenders and investors, they would need to rest on a standardized definition and method for avoided losses.

Quantifying resilience benefits would help build the business case for investment in adaptation measures that might otherwise be difficult to justify. Adaptation measures are funded upfront but deliver most returns only in the form of avoided losses, often over a long time horizon. Quantification turns an uncertain future benefit into a number upon which a business case can be built, making the investment more likely to proceed.

Climate risk intelligence such as sectoral and geographic risk trends, scenario analysis and insights derived from catastrophe modelling can help stakeholders better understand physical climate risk, assess adaptation needs and make more informed financing and investment decisions. While insurers routinely share risk insights through research and collaborative initiatives, much of the value they create comes from combining modelling, risk engineering, underwriting and claims experience to generate decision-useful assessments of risk. Industry-wide initiatives such as the Insurance Institute for Business & Home Safety (IBHS) in the United States and Australia's bushfire resilience certification scheme demonstrate how insurers can work with other stakeholders to strengthen the evidence base for resilience and accelerate the adoption of effective adaptation measures.

Insurers can, however, evidence only what their data and methodologies enable them to assess. Quantifying an adaptation measure's effectiveness requires sufficient loss experience or engineering evidence, along with confidence that the measure is in place and is properly maintained. For some measures, such as nature-based solutions, methodologies for attributing risk reduction to a specific intervention are still developing.

CASE STUDY 1

Quantifying physical climate risks to nature-based solutions

A global diversified conglomerate sought to protect a carbon-credit-generating forestry asset in Louisiana, USA, from a range of physical climate risks and natural catastrophes. Forestry projects are exposed to hazards such as wildfires, floods and extreme weather, which can result in financial losses and undermine the long-term value of the investment.

Aon undertook a climate analytics assessment to quantify the physical risks facing the asset. Using climate and catastrophe modelling, including simulations of 10,000 years of potential events, Aon identified the key hazards affecting the project, including hurricanes, wildfires, drought and excessive rainfall. The analysis quantified the likelihood and severity of losses, identified tropical cyclone as the primary driver of risk, and highlighted practical adaptation measures to strengthen resilience and protect the long-term value of the investment.

Building on this analysis, Aon arranged nature restoration and conservation insurance covering perils including fire, flooding, storms, heatwaves and lack of precipitation. The policy provides protection against replanting costs, property damage and restoration expenses, helping to reduce the financial impact of catastrophic events and support recovery following a loss.

This example illustrates how climate analytics and insurance can work together to help organizations understand, quantify and manage climate-related risks, supporting continued investment in nature-based solutions despite increasing exposure to extreme weather and natural hazards.

CASE STUDY 2

Connecting climate science and insurance for resilience

In 2026, Generali and the European Centre for Medium-Range Weather Forecasts (ECMWF) launched a strategic collaboration to strengthen the use of climate data in the insurance industry. The partnership aims to bridge the gap between cutting-edge climate science and risk management practices, helping to better understand, assess and communicate climate-related risks.

By combining ECMWF's expertise in climate modelling, weather forecasting and Copernicus services with Generali's insurance and risk management knowledge, the initiative explores how climate information can support more informed decision-making across the insurance value chain. Particular attention is given to the practical application of data from the Copernicus Climate Change Service (C3S) and the Copernicus Atmosphere Monitoring Service (CAMS) to enhance risk awareness and resilience.

The collaboration highlights the importance of translating publicly available climate information into actionable insights that help communities, businesses and institutions better prepare for future climate risks.

b. Enabling resilience using risk management and engineering capabilities

Insurers have developed deep expertise in assessing, managing and reducing risk through their routine risk management and underwriting activities. Because they work across asset types, sectors and geographies, they can bring an informed third-party perspective, drawing on emerging good practice and resilience solutions that individual asset owners may not encounter in their own portfolios.

Insurers can use these capabilities to enable resilience by advising on adaptation measures that reduce the impacts of physical climate risk. This advice can span engineered, operational and nature-based solutions, from changes to asset design and construction materials, to maintenance practices and emergency planning. Increasingly, insurers are also sharing this expertise with public authorities, helping inform resilience planning for communities and public infrastructure.

Insurers can help policyholders identify which adaptation measures are likely to deliver the greatest improvement in resilience relative to their cost. This may be achieved through risk engineering surveys and site assessments for larger commercial risks, or through digital tools, vulnerability self-assessments, prevention checklists and other forms of guidance for retail customers. Some customers face a long list of possible measures and a limited budget. By assessing the relative effectiveness of different options, insurers can help direct investment towards the measures that will do most to strengthen resilience, making better use of the capital available.

However, insurers' advice is generally applied asset by asset and cannot fully compensate for poor land-use planning or construction standards. Business continuity can also be disrupted by physical climate events that do not directly affect an asset but impact a business's suppliers or wider value chain. Where development continues in high-risk areas, or design features neglect climate conditions, vulnerability is locked in from the outset, bringing assets closer to the limits of adaptation.

Resilience must therefore be assessed beyond individual assets, considering dependencies on wider systems and ecosystems, such as critical infrastructure, supply chains and natural ecosystems, which can influence long-term resilience outcomes. For example, poorly designed coastal defences may protect one location, while increasing erosion elsewhere.

As outlined in chapter 2, adaptation complements climate mitigation. Advice and risk engineering should therefore look for opportunities to strengthen resilience while reducing greenhouse gas emissions and avoid measures that lock in long-term dependence on emissions-intensive technologies. For example, nature-based adaptation measures such as restoring mangroves in suitable coastal locations can reduce flood and erosion risk while sequestering carbon.

CASE STUDY 3

Protecting communities and cities against extreme heat

In 2026, Germany recorded its second-warmest summer since measurements began, with an average temperature of 19.6°C, around 22 days above 30°C and about five days above 35°C.[14] Protection against extreme heat has therefore become a central task of modern urban development, particularly for cities where dense construction and sealed surfaces intensify the effects.

The State of North Rhine-Westphalia, the City of Cologne and Zurich Insurance in Germany ("Zurich") launched the model project “Cool North Rhine-Westphalia”, the first public-private partnership of its kind in Germany. Cologne acts as the national pilot city, the state ministry funds the initiative, and Zurich contributes risk analysis and on-the-ground assessments delivered through five integrated work packages.

Collaboration is central. Zurich risk engineers are assessing up to 25 high-priority locations together with municipal departments, focusing on schools, daycare centres, hospitals, care homes and heavily used public spaces where vulnerable people are most exposed. Experts evaluate shading, surface sealing, building heat load, quality of stay and existing protection measures.

The results are being prepared as a practical investment roadmap, identifying where shading, urban greening, surface unsealing, water management and cooling spaces deliver the greatest resilience benefit at the lowest cost.

Source: Cooles Land. Stadtentwicklung weitergedacht | Zurich Gruppe Deutschland

14 Deutscher Wetterdienst, Deutschlandwetter im Sommer 2026 [German weather in summer 2026], preliminary results, 31 August 2026

CASE STUDY 4

Enabling household flood resilience through digital technology

As part of its "Be Informed, Prepared and Resilient" campaign, Aviva has introduced the Resilico Connect app to home insurance customers whose homes have been identified as being at high risk of flooding.[15] The app allows customers to sign up for flood alerts, provides practical advice to help protect homes and possessions, and also allows users to create a personalized flood plan directly on their smartphone so residents can take pre-emptive action.

Aviva research suggests that one in nine new homes built in England in the last three years is at medium or high risk of flooding, and 30% of new homes built in 2024 will be at some risk of flooding by 2050.[16] Floodwater can also cause irreparable damage to vehicles. In 2025, 55% of flood-related motor claims resulted in the vehicle being written off, with repairable vehicles costing an average of GBP 5,872.[17] Customers with a flood plan in place may be able to move their car to higher ground before the water arrives.

c. Rewarding and unlocking resilience through underwriting

Rewarding resilience

By quantifying how adaptation measures improve an asset's risk profile, insurers can incorporate these factors into underwriting, including pricing decisions, and reward adaptation and resilience with favourable terms. Where measures reduce expected losses, this can be reflected in lower premiums, reduced excesses, higher coverage limits and better renewal terms. Most fundamentally, it can help keep cover available in more locations for longer as physical risk increases. In this way, resilience is transformed from a cost with an uncertain future benefit into an investment that delivers a tangible return, helping to overcome one of the key barriers to resilience investment.

Rewarding resilience in underwriting depends on it being visible and consistently recognized; insurers need confidence that measures are in place and maintained, and policyholders need to know which adaptation measures will be recognized. Where policyholders are told how their risk is assessed and which measures would improve it, as required under California's Safer from Wildfires regulation (see case study in chapter 4), the incentive becomes clear and actionable. However, even where risk reduction is well evidenced, it accounts for only part of the price. Insurance pricing is inherently complex, and premiums reflect not only the physical climate risk of an individual asset but also a wider range of factors including portfolio-level exposures, reinsurance costs and prevailing market conditions. As a result, even where an adaptation measure demonstrably reduces expected losses, that reduction may not translate directly or proportionately into a lower premium.

Insurers also cannot reward all adaptation measures. The risk reduction from elevating buildings in a flood-prone area can be modelled and reflected in pricing, whereas measures that deliver collective rather than asset-specific benefits are considerably harder to quantify and attribute. Improved community preparedness contributes significantly to resilience in practice but is difficult to reflect in the terms offered to any individual policyholder. The same is true of nature-based adaptation measures such as restored wetlands, which may reduce flood exposure across multiple assets and

15 Aviva, Aviva introduces app to help customers get flood ready, 2026. Available at: aviva.com/newsroom/news-releases/2026/04/aviva-introduces-app-to-help-customers-get-flood-ready/

16 Aviva, Proportion of new homes built in flood areas rises to one in nine, 2026: Available at: aviva.com/newsroom/news-and-research-overview/news-releases/2026/02/proportion-of-new-homes-built-in-flood-areas-rises-to-one-in-nine/

17 Aviva motor claims relating to flood from 2024 to 2025

communities at once. Policy action may be required to advance more quickly the understanding and rewarding of such measures, as in Colorado.[18]

The price of insurance starts from the risk of the property, business or activity covered. Thus, as physical climate risk increases, premiums will likely continue to rise to reflect that level of risk. Maintaining affordability and availability of insurance therefore requires either investment to reduce the underlying risk or decisions about how the higher cost of risk is shared, including through targeted public support.

CASE STUDY 5

Quantifying and rewarding resilience with improved underwriting terms

United States of America: Wildfires caused by power lines can be more destructive than other ignition sources, creating growing litigation, insurance-capacity and creditworthiness concerns for a US energy provider with annual revenues of approximately US$ 30 billion. Aon brought together climate risk advisory, commercial risk and reinsurance specialists to develop a bespoke model that quantified the client's physical-asset and third-party liability exposure, supported by valuations from Aon's proprietary database. The resulting analysis strengthened the client's insurance negotiations and risk-management strategy, delivering approximately US$ 1 million in savings, equivalent to roughly a 50% reduction in its total wildfire liability premium.

Australia: An Australian insurer identified the opportunity to reduce insurance premiums by up to 20% in North Queensland through targeted, government-funded home resilience retrofits. This approach is complemented by Suncorp Insurance's Build it Back Better™ initiative, which embeds resilience directly into insurance: following significant insured damage of more than AUD 50,000, eligible homeowners can access an additional AUD 7,500 to 15,000 for upgrades that strengthen homes against risks including cyclone/storm, flood and bushfire. The insurance contribution takes account of any available government subsidy, demonstrating how public funding, household resilience investment and insurance can work together to reduce future losses and support longer-term affordability and insurability.

Unlocking resilience

While *rewarding resilience* addresses adaptation measures already in place, insurers can also *unlock resilience* that has yet to be built. By underwriting the risks of developing, deploying and operating resilience-building projects, they reduce uncertainties that could otherwise prevent investment from proceeding.

The scale of resilience still to be built is considerable. Although adaptation measures are increasingly available, MSCI data and analysis suggest that many companies highly exposed to physical climate risks have not implemented sufficient adaptation measures and are consequently unprepared for the impacts, as shown in Figure 7. The gap is most pronounced for wildfire.

18 Colorado General Assembly, HB25-1182: Risk Model Use in Property Insurance Policies, 2025. Available at: leg.colorado.gov/bills/HB25-1182

Industry	Extreme heat	Tropical cyclones	Wildfire
Gas utilities	100.0%	100.0%	100.0%
Food products	58.3%	100.0%	100.0%
Semiconductors & semiconductor equipment	93.8%	50.0%	95.2%
Consumer staples distribution & retail	60.0%	75.0%	100.0%
Metals & mining	80.0%	75.0%	65.2%
Industrial conglomerates	33.3%	100.0%	66.7%
Independent power & renewable electricity products	100.0%	0.0%	100.0%
Oil, gas & consumable fuels	68.4%	57.1%	63.6%
Ground transportation	66.7%	0.0%	100.0%
Transportation infrastructure	77.8%	0.0%	85.7%
Real estate management & development	25.0%	28.6%	100.0%
Water utilities	50.0%	0.0%	100.0%
Health care providers & services	71.4%	0.0%	66.7%
Electric utilities	68.8%	0.0%	66.7%
Air freight & logistics	33.3%	0.0%	100.0%
Marine transportation	50.0%	66.7%	0.0%
Diversified telecommunication services	14.3%	0.0%	100.0%
Multi-utilities	50.0%	50.0%	0.0%
Paper & Forest Products	100.0%	0.0%	0.0%
Wireless Telecommunication Services	28.6%	0.0%	66.7%

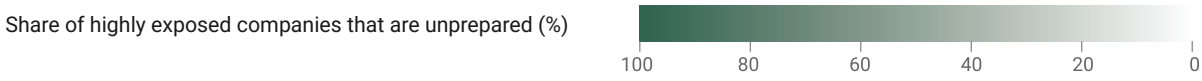


Figure 7: Share of highly exposed companies that are unprepared for key climate-related events, by industry. Source: MSCI Institute analysis using MSCI Sustainability & Climate data as of 31 December 2025. Analysis covers MSCI All Country World Index (ACWI) constituents across the 20 GICS industries most relevant to key climate-sensitive sectors. Companies are considered highly exposed to a hazard if their hazard intensity score exceeds 7 on a 0–10 scale, reflecting hazard intensity or frequency at company asset locations. Companies are classified as unprepared if they lack at least one adaptation and resilience (A&R) measure for a hazard to which they are highly exposed.

Through specialized insurance solutions, insurers can help project owners manage uncertainty throughout the project lifecycle, providing confidence that investments in resilience can be delivered and will perform as intended:

- **Construction risk cover** protects the development of resilience assets, such as urban cooling networks, against damage, third-party liability claims or construction delays arising from insured events during construction.

- **Performance and operational risk cover** provides protection if an adaptation measure fails to achieve agreed outcomes or experiences operational disruption; for example, if a flood defence system does not meet its specified protection standards.

- **Technology risk cover** supports the deployment of innovative resilience solutions, such as advanced drought-resilient water recycling technologies, by covering risks associated with unproven technologies and limited operational track records.

d. De-risking resilience through risk transfer

Through the roles described above, insurers can help households, businesses and governments reduce physical climate risk. However, adaptation measures cannot eliminate these risks entirely. Protection standards may be exceeded, hazards may evolve over time, and some risks cannot be reduced at a reasonable cost. As a result, a residual level of risk remains even after adaptation measures have been implemented.

Resilience and insurance therefore play complementary roles. Adaptation measures reduce the losses that are likely to occur. With less risk to manage overall, households, businesses and governments can retain a greater share of risk themselves. The residual risk can then be transferred through insurance and reinsurance, ensuring that severe and less predictable losses can be absorbed and recovered from efficiently.

This has direct consequences for financing. Insurance converts an uncertain future liability into a known annual cost in the form of a premium, reducing uncertainty around future project performance and cash flows. This matters because insurance is typically renewed annually, while the loans and investments it supports often run for decades. While multi-year insurance contracts are available, demand is often limited, as customers may be reluctant to commit to the risks and costs of longer-term cover. Longer terms also require insurers to price in greater uncertainty and are constrained by prudential requirements, so such cover is likely to cost materially more. The challenge is therefore to consider what actions can be taken today to maintain access to insurance as climate risks evolve over the lifetime of an asset. Taking such actions can give lenders and investors greater confidence in the resilience of the asset and the project's ability to generate returns. Cover is often a condition of financing, with lenders requiring evidence of insurance before providing funds. Where residual climate risk cannot be insured, financing can stall even on an asset that is otherwise well adapted. By enabling residual risks to be retained or transferred, insurance helps unlock the capital needed to develop and deploy adaptation measures.

An additional benefit is that adaptation measures may make more efficient use of insurance and reinsurance capacity, which is scarce in some markets. By reducing expected losses, adaptation measures reduce the amount of risk that needs to be transferred, helping insurers maintain coverage and support risk transfer across a larger number of assets and communities. This can help preserve the availability of insurance in areas vulnerable to increasing physical climate risk, supporting continued investment and economic activity.

Some forms of risk transfer can further support resilience by reducing uncertainty around post-disaster funding. Parametric insurance supports resilience by paying out automatically once a defined hazard parameter or threshold is reached (e.g. wind speed or rainfall level), rather than after the damage has been assessed. This is particularly valuable where losses are real but hard to evidence (e.g. income lost during a heatwave), where claims assessment capacity is limited, and where low-income communities are affected and require immediate liquidity. The main drawback is that a payout based on a hazard threshold may not match the loss actually incurred, known as "basis risk". Basis risk remains a key issue, particularly in localized and complex circumstances, but several

factors have reduced basis risk over the years and supported the development and application of parametric insurance at every level, from individual smallholder farmers and financial institutions to cities and entire countries. These include better hazard data and modelling, a deeper understanding of vulnerabilities, advances in digital and geospatial technology (including Internet of Things sensors such as river-level gauges and soil moisture probes), improved product design, and more historical claims and market experience.

Where risks remain elevated even after adaptation, the capacity of insurers and reinsurers alone may not be enough to keep cover available. In such cases, public-private risk-sharing arrangements can help maintain the availability and affordability of cover. Effective arrangements provide capital or reinsurance backstops for losses beyond private-market capacity and link support to investment in resilience. Existing schemes take different approaches to these design choices, as Table 1 shows.

Table 1: Public-private partnerships for natural hazard protection gaps: Comparison of selected countries

		France	United Kingdom	Brazil	Mexico
Insurance scheme		**Cat Nat (CCR)**	**Flood Re**	**Rural Insurance**	**Natural Disaster Fund Programme** (Catastrophe Insurance Policy & Catastrophe Bond)
Year		**1978, 1982**	**2016**	**2003**	**1996**
Natural hazard coverage		**Multi-peril**	**Single peril**	**Multi-peril**	**Multi-peril**
Risk reduction & prevention measures	Mandatory, tied to insurance cover	✓	X	X	X
	Incentivized (e.g. Government programme)	✓	✓	✓	Partially
	Government fund	✓	X	✓	Partially
Role of government	Risk capacity (balance sheet)	X	X	X	✓
	Backstop: guarantee/ liquidity	✓	✓	Partially	Partially
	Social contract (e.g. rate adjustment)	✓	✓	Partially	X

Source: Zurich Insurance Group analysis

CASE STUDY 6

Creating financial resilience through innovative risk financing

The Global Disaster Resilience Vehicle (GDRV), currently being established (subject to regulatory approval), is a blended finance initiative developed by Aon and the United Nations Capital Development Fund (UNCDF) to help address disaster protection gaps in climate-vulnerable markets. The model is designed to bring together donor-supported capital, local insurers and global reinsurance capacity to expand access to disaster risk protection while supporting the development of local insurance markets.

The initial proof of concept focuses on Pacific markets exposed to perils such as tropical cyclone, earthquake, tsunami and flood, with potential expansion into other regions over time. By aggregating risk and accessing international reinsurance markets, the structure aims to increase available capacity, improve affordability and support faster access to post-disaster funding.

The GDRV seeks to demonstrate how public and private capital can work together to strengthen resilience, support local insurance ecosystems and encourage increased participation from commercial insurance and reinsurance providers over time.

e. Strengthening resilience during recovery by building back better

Post-event recovery represents one of the most cost-effective opportunities to strengthen resilience. Because repair and reconstruction work is already under way, adding resilient design features such as flood-resistant materials may only cost a little more. By contrast, retrofitting an undamaged property requires a separate investment and is therefore less likely to occur.

Whether the opportunity is taken depends partly on the policy terms. Most insurance cover is designed to restore an asset to its pre-loss condition, which can result in the same vulnerabilities being rebuilt. Some policies now allow claims payments to be used for more resilient repairs, so that a property damaged by flooding can be reinstated to withstand future floods better. However, cover usually extends on a like-for-like basis, so the additional cost of resilient repair typically falls to the business owner or household, at a time when they are least able to meet it.

Arrangements that share the additional costs of building back better can be agreed between insurers, households, businesses and, where relevant, public grant providers. Such “build back better” arrangements are essential if recovery is to reduce future risk rather than simply restore previous vulnerabilities. Furthermore, rebuilding more resilient assets avoids the emissions associated with repeated carbon-intensive reconstruction, and these assets are more likely to withstand future physical risk events. This reinforces the point that adaptation and mitigation can and need to advance together.

Claims also provide the most direct real-world test of whether adaptation measures work as intended. Where two similar assets are affected by the same event and only one has adaptation measures in place, the difference in the damage each sustains over time offers direct evidence of whether the measures have delivered. This helps address the evidence gap mentioned earlier.

Repeated losses in the same location point to a different conclusion. Where an asset is damaged repeatedly, rebuilding alone is not a sustainable response, and the question becomes whether it can continue to be occupied at all. These are the circumstances in which relocation, managed retreat or

public intervention need to be considered, marking the point at which the soft limits to adaptation described in chapter 2 begin to harden.

CASE STUDY 7

Building resilience by building back better

In the United Kingdom of Great Britain and Northern Ireland, Flood Re's Build Back Better scheme demonstrates how the claims process can be used to strengthen resilience after a flood. Through participating insurers, eligible households can receive up to GBP 10,000 for property flood-resilience measures, in addition to the cost of repairing the damage caused by the flood. One participating insurer, Aviva, has supported over 400 eligible customers under this scheme.[19]

The measures are tailored to the property and may include changing materials used in the construction of the property, using flood barriers on doors or raising electrics and plug sockets, among other measures. These interventions can help prevent flood water entering a property or, where it does, limit the damage incurred.

While conventional claims generally restore properties to their pre-loss condition, Build Back Better provides dedicated funding for additional measures that may not otherwise be affordable at the point of recovery. In doing so, it turns a claim into an opportunity to reduce future damage, disruption and recovery time.

Sources: Flood Re, Build Back Better (floodre.co.uk/buildbackbetter)

19 Building Future Communities Report 2025

4. Recommendations

As physical climate risks intensify, maintaining the resilience of assets, businesses and communities increasingly requires action across stakeholder groups. The recommendations that follow are organized around the key areas where action is needed to accelerate systemic climate resilience, with each requiring different stakeholders to contribute according to their roles and capabilities.

One principle underpins these recommendations: efforts to improve affordability, availability and adequacy of insurance must be accompanied by adaptation measures that reduce risk before losses occur. Without risk reduction, support for affordability treats the symptom rather than the cause.



Framework **Intelligence** **Risk reduction** **Recognition** **Finance**

1. Set the framework for resilience

Policymakers, regulators and public authorities:

- Clarify public and private actors' roles in managing climate risks and losses. Where the potential protection gap and economic impact justify it, design public-private risk-sharing arrangements that maintain the availability and affordability of cover, linking support to the delivery of resilient outcomes so that incentives to reduce risk are preserved.
- Integrate resilience standards into land-use planning, development and building regulations to reduce exposure and avoid locking in vulnerability in new developments, supported by targeted incentives for adaptation and retrofitting.
- Develop national adaptation plans (NAPs) with clear targets, metrics and cross-sector governance. Translate these into investable adaptation measures with clear priorities, funding responsibilities and measurable outcomes, using public and concessional finance to attract private investment in developing countries.

2. Strengthen climate-risk intelligence and make resilience measurable

- **Insurers, lenders, investors, policymakers, regulators and public authorities:** Develop shared climate-risk metrics and methodologies that demonstrate how adaptation measures reduce risk. Include measures that remain difficult to quantify (e.g. behavioural, place-based and nature-based solutions) and make decision-useful insights more widely accessible.
- **Lenders and investors:** Incorporate insurance risk insights and resilience considerations, including hazard data, loss information and resilience expertise, into lending and investment decisions.

3. Act early to reduce risk and embed resilience

- **Insurers:** Establish dedicated capabilities to support and advise on resilience-building, especially in developing and vulnerable countries, including where these fall outside insurers' core commercial markets.
- **Businesses:** Incorporate resilience (including across suppliers and wider value chains) and future insurance availability, pricing and terms as strategic business variables into investment, procurement and financial planning decisions. Recognize that resilience is a business-wide responsibility rather than solely a risk management function.
- **Businesses and households:** Engage insurers early to understand physical climate risks and identify, implement and maintain appropriate adaptation measures before losses occur.

4. Recognize and reward the value of resilience

- **Insurers:** Explain to policyholders how their risk is assessed, which adaptation and other risk reduction measures are recognized in underwriting and how those measures affect the insurance terms offered.
- **Insurers, lenders, investors and businesses:** Strengthen understanding of how changing risk profiles, insurance affordability and insurability may affect asset values, credit and default risk, access to finance and long-term investment decisions. Recognize that insurance is typically renewed annually while loans and investments may run for decades.
- **Businesses and households:** Assess adaptation measures based on the long-term value they create, including less damage and disruption, lower cost of repair and potentially more favourable insurance terms.

5. Mobilize finance and insurance for resilience and recovery

- **Insurers:** Develop and scale cover for the construction, performance and technology risks of new resilience projects.
- **Insurers:** Expand options for resilient repair after a claim, so that policyholders rebuild stronger rather than restore the same vulnerabilities, including arrangements to share the additional cost with businesses and public bodies.
- **Lenders and investors:** Recognize adaptation investment in financing terms and engage with insurers early when structuring finance for resilience projects since insurance availability and terms affect project bankability and investability.

CASE STUDY 8

Incentivizing wildfire risk reduction through insurance regulation

California is highly exposed to wildfire risk. Successive severe wildfire seasons from 2017 onwards led to rate increases, non-renewals and insurer exits, which drove rapid growth in the state's Fair Access to Insurance Requirements (FAIR) Plan and widened the protection gap. These pressures were compounded by years of constrained and capped rates that did not fully reflect rising risk.

In 2022, California's Insurance Commissioner introduced the "Safer from Wildfires" regulation to ensure that wildfire risk reduction measures are recognized within insurance underwriting.

The regulation requires insurers that incorporate wildfire risk into their rating plans to account for specified community-level and property-level risk reduction measures when assessing risk and setting premiums. These measures include recognized community wildfire preparedness programmes, measures addressing the immediate surroundings of buildings, and building-hardening actions such as fire-resistant vents.

A notable feature of the regulation is its transparency requirements. Insurers must provide policyholders with their wildfire risk score or classification, explain how it affects their premium, identify actions that could reduce wildfire risk, and indicate the associated premium impact of those actions.

By requiring insurers to recognize specified risk reduction measures and explain their premium effects, the regulation strengthens incentives to reduce wildfire risk and makes the value of risk reduction more transparent. Premium savings alone do not fully offset risk reduction costs or guarantee that cover remains available. The regulation is therefore best seen as one part of a broader strategy that also needs credible risk modelling, adequate pricing, financing support and community-scale risk reduction.

Source:

California's wildfire hell: how 2020 became the state's worst ever fire season | California | The Guardian

California Code of Regulations, Article 4, Section 2644.9—Consideration of Mitigation Factors Wildfire Risk Models | California Code of Regulations | Justia

5. Conclusion

Physical climate risk is increasing the need for adaptation and resilience to protect communities, businesses and economies. Insurers are well placed to support this across a range of activities, helping society not only to recover and build back better after disaster strikes, but also to prevent losses, maintain operational continuity and build better beforehand. Their risk management capabilities increasingly allow them to quantify the value of adaptation measures, advise on where investment will be most effective, recognize risk reduction in the terms they offer, underwrite the delivery of new adaptation measures, transfer the residual risk that adaptation cannot remove, and support more resilient recovery when losses occur.

Together, these roles can help keep insurance affordable and available which, in turn, strengthens bankability and investability of climate-vulnerable assets and projects. The result is a reinforcing cycle in which insurance supports resilience, resilience sustains insurability, and insurability unlocks finance for further resilience. Over time, this can shift spending away from paying for losses after they occur and towards reducing them in advance.

Insurers cannot achieve this alone. Not every resilience-building measure can be reflected in an individual insurance policy, and where adaptation reaches its limits, public support will be needed to keep cover affordable. To be rewarded at scale, resilience must be visible and consistently recognized, which depends on a stronger evidence base for how adaptation measures perform and on standards that allow them to be assessed consistently. Households, businesses, lenders, investors, policymakers, regulators and public authorities each have a role in reducing risk, mobilizing capital and creating the conditions for resilience to be systematically recognized. The common requirement is earlier engagement, so that insurance capabilities support risk reduction before losses occur rather than being called upon primarily for recovery afterwards.

While this paper focuses on how insurers' risk intelligence and risk transfer capabilities can support adaptation and resilience, a few related topics warrant further exploration to better understand and harness the full role of the insurance industry in helping build climate-resilient communities and economies:

- **The resilience role of insurers as investors:** How insurers can use their investment portfolios to enhance and finance adaptation and resilience.
- **The resilience role of life and health insurers:** How life and health insurers can support societal resilience to climate-related health impacts.
- **Insurance and nature-based resilience:** How insurance can help value, protect and increase investment in natural assets and nature-based adaptation measures.

The choice is stark: Invest in resilience now or pay even more for losses later. By working together, exercising their agency and acting urgently, the insurance industry and key stakeholders across the economy can make proactive risk reduction before losses occur the norm rather than the exception. Ultimately, in an era of rising physical climate risk, transforming vulnerability to insurability and catalyzing systemic resilience is no longer a choice, but a fundamental economic and social imperative.

APPENDIX

Insurers and climate risk: Understanding the insurance risk management continuum

The insurance industry functions as both a risk intelligence system and a risk transfer system. Insurance is often seen primarily as a mechanism to recover financial losses after they occur, but this is only one part of a broader set of capabilities for assessing and managing physical climate risk.

Through decades of underwriting and claims experience, insurers have developed a detailed understanding of insured assets and how physical risks impact them. Their activities form a continuous cycle in which data and modelling inform risk assessment; risk engineering and advice help insurers identify vulnerabilities and help policyholders reduce risk; underwriting turns those assessments into decisions on coverage and cost; risk transfer distributes the financial consequences; and claims experience feeds new evidence back into data and modelling, closing the *risk management continuum*.

These capabilities generate risk insights, incentives and market signals that shape the decisions of lenders, investors, policymakers, businesses and households across the economy. Understanding these capabilities provides the foundation for examining how insurance can support resilience.

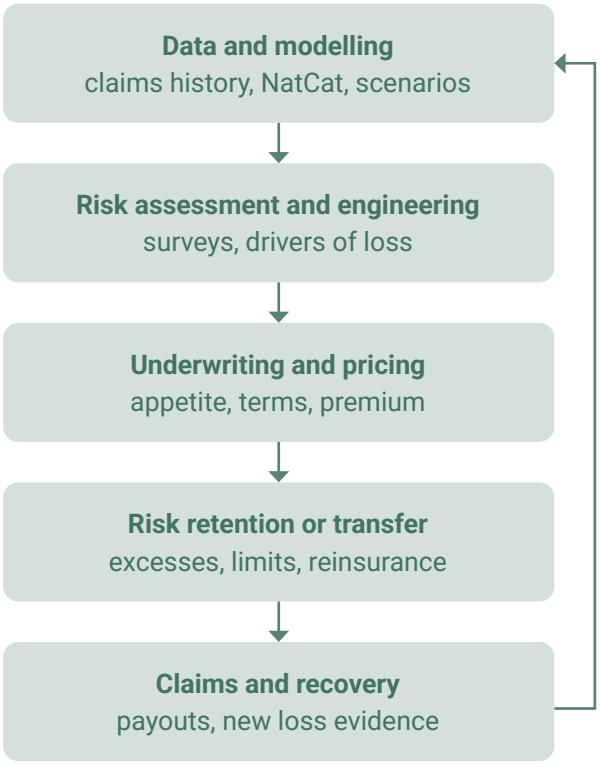


Figure 8: The insurance *risk management continuum* relative to climate adaptation and resilience

a. Data and modelling

The insurance market holds vast quantities of current and historical claims and loss data, with detailed records of insured assets' locations and features, the nature and severity of physical risk events, the damage incurred, repair or replacement costs, and business interruption losses. For example, decades of claims data reveal how construction materials perform in floods, how types of roof influence wildfire losses, and how building height affects windstorm damage. Together, these datasets show how assets have performed in past hazard events and how they may perform in the future.

Insurers also use natural catastrophe (NatCat) models to assess the financial impacts of physical hazards across individual assets, portfolios and regions. Perils are commonly grouped into two types. Primary perils, such as tropical cyclones (including hurricanes), happen less often but can cause very large losses. Secondary perils, such as severe convective storms (including hail), floods, droughts and wildfires, happen more often and have typically caused small to mid-sized losses individually, but together they can add up to very large losses: severe convective storms have now overtaken tropical cyclones as the costliest insured peril of the 21st century to date.[20] NatCat models cover both types and help insurers assess low-probability, high-impact events that may not have historical precedents.

Claims data and NatCat models remain foundational, but climate change is reducing the reliability of purely backward-looking approaches. Insurers are therefore supplementing them with forward-looking scenario analysis, which examines how perils may evolve under different warming pathways; for example, through rising temperatures exacerbating subsidence, or sea-level rise increasing flood exposure. This enables underwriting appetite, exposure management and resilience strategies to be adjusted before those impacts emerge fully in loss experience.

Much of this risk intelligence is proprietary, used internally and understood primarily by sophisticated market participants, reflecting its value as a source of competitive advantage. Insurers do, however, communicate risk more widely through public risk insights, education and practical guidance that help businesses, households and public authorities to make better-informed resilience decisions.

b. Risk assessment and engineering

Insurers use their climate risk insights and tools to support risk assessment and engineering activities, working closely with clients to understand physical climate risks and advising on practical measures that reduce expected losses, business and supply chain disruption, and that support insurability.

To do so, insurers conduct site visits and technical assessments to understand first-hand how hazards such as flooding, wildfires and hurricanes may affect facilities, infrastructure, operations and supply chains. They review existing loss prevention measures and emergency response capabilities to identify vulnerabilities and opportunities to reduce risk.

They then work with clients to develop targeted recommendations. For example, where a manufacturing site has an elevated flood risk, risk engineers can help determine the most vulnerable areas and recommend interventions such as flood barriers, improved site drainage, relocation of stock or critical machinery, and operational changes. For households and smaller businesses, insurers more often share their expertise through guidance and digital risk tools.

Risk engineering has long been a core part of the service insurers provide, and insurers are now extending this expertise to physical climate hazards, supported by climate analytics.

c. Underwriting

Risk assessment and engineering insights inform underwriting decisions, helping insurers evaluate whether a risk falls within their risk appetite and, if so, on what terms cover can be offered. On this basis, insurers decide whether to accept (or "bind") the risk and how to price it. Premiums are driven in part by expected losses, based on the frequency and severity of physical risk events, but also reflect the cost of reinsurance, expenses, inflation, portfolio concentration and profit. Policy terms,

20 Aon, *Climate and Catastrophe Insight*, 2026. Available at: aon.com/en/insights/reports/climate-and-catastrophe-insightaon.com/en/insights/reports/climate-and-catastrophe-insight

including limits, excesses and exclusions, determine how losses are shared between the insurer and policyholder and may place certain perils or locations outside the scope of cover.

Underwriting decisions also consider portfolio-level exposures to maintain diversification and avoid excessive concentrations of risk. Insurers may therefore limit exposure to regions or perils where they already have significant concentrations, even where individual risks are well managed.

Because pricing and terms reflect each asset's physical climate risk, alongside a wide range of other factors, otherwise similar assets may attract different premiums and terms. These decisions also send signals to lenders and investors: favourable terms suggest manageable risk, while rising premiums or tighter conditions prompt closer scrutiny of an asset's viability and durability and may weigh on its valuation.

d. Risk transfer

Insurance enables risk to be shared across policyholders, insurers, reinsurers and capital markets.

Policyholders transfer risk to insurers by paying premiums, while typically retaining part of it themselves through excesses (deductibles) and policy limits. Some larger businesses deliberately retain much more; for example, through self-insurance or captive insurance companies, transferring only the risk they cannot or choose not to absorb.

Insurers underwrite large numbers of policyholders who contribute premiums into a common pool. This pooling, often called mutualization, reflects a principle of solidarity where the premiums of the many help cover the losses of those who experience an insured event. For this to work sustainably, insurers need to maintain a diversified pool of risks and avoid excessive concentration in any one location or hazard, so that losses in one area do not undermine their ability to meet claims elsewhere. Climate change is making this more challenging by increasing both the scale and correlation of losses, placing greater pressure on the ability to pool risk across policyholders and geographies. Floods, wildfires and other large-scale hazards can affect thousands of properties simultaneously, producing a surge in claims.

To withstand such events, insurers are required to hold capital against potential future losses (e.g. under Solvency II in the European Union and Solvency UK in the United Kingdom of Great Britain and Northern Ireland), providing a buffer to absorb claims that exceed premium income. This helps ensure claims can be paid even during extreme events, supporting wider economic stability.

Insurers also purchase reinsurance to spread risk further, particularly for large, geographically concentrated events such as floods and wildfires. Some of this risk is passed on to capital markets through catastrophe bonds and other insurance-linked securities, giving investors exposure to NatCat risk.

e. Claims and recovery

When an insured loss occurs, the claim is the mechanism through which risk transfer is realized. Subject to policy terms and conditions, claims provide the financial compensation needed to repair damage and replace lost assets, fulfilling the core purpose of insurance and supporting long-term economic development.

This financial protection enables post-event recovery. Claims help households rebuild homes damaged by storms or floods, fund businesses to repair assets and resume operations, and support governments in reinstating damaged infrastructure. Timely access to funding helps limit the wider disruption caused by loss events.

The claims and repair process also provides evidence on how hazards translate into damage and financial loss in practice. This feeds back into models, risk assessments and underwriting decisions, closing the *risk management continuum* and improving the insurance industry's understanding of risk and resilience.

UN environment programme

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UNEP Finance Initiative brings together a large network of banks, insurers and investors that catalyzes action across the financial system to deliver more sustainable global economies.

For more than 30 years the Initiative has been connecting the UN with financial institutions from around the world to shape the sustainable finance agenda. We've established the world's foremost sustainability frameworks, helping the finance industry achieve sustainability goals, address sustainability risks and identify the business opportunities in taking a responsible approach to banking and insurance.

Convened by a Geneva, Switzerland-based secretariat, more than 550 banks and insurers are individually implementing UNEP FI's Principles for Responsible Banking and Principles for Sustainable Insurance. Financial institutions work with UNEP FI on a voluntary basis to apply these industry frameworks and develop practical guidance and tools that drive institutional change, shaping the future of sustainable finance and positioning their businesses for the transition to a sustainable and inclusive economy. In parallel, UNEP FI also drives systems change and fosters enabling conditions in service of the broader mission to mobilize and align private finance to help achieve the UN Sustainable Development Goals.

Founded in 1992, UNEP FI was the first organization to engage the finance sector on sustainability and incubated the Principles for Responsible Investment, now the world's leading proponent of responsible investment.

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